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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/835,820	04/17/2001	Tomohisa Hoshino	P 280192 EL00028CDC	5539

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EXAMINER
LUU, CHUONG A

ART UNIT	PAPER NUMBER
2825	

DATE MAILED: 03/17/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/835,820	HOSHINO ET AL.	
	Examiner	Art Unit	
	Chuong A Luu	2825	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *03* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 December 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-9 and 11-17* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9 and 11-17* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Request For Continued Examination (RCE)

The request filed on December 23, 2003 for a Request for Continued Examination (RCE) under 37 CFR 1.53(d) based on parent Application No. 09/835,820 is acceptable and a RCE has been established. An action on the RCE follows.

PRIOR ART REJECTIONS

Statutory Basis

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The Rejections

Claims 1-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hausmann et al. (U.S. 6,475,902 B1) in view of Lee (U.S. 5,665,659).

Hausmann discloses a method of depositing a metal nitride material with

(1) forming a barrier layer (119) on an insulating film (114) covering a substrate (112) (see Figure 1);

forming, after said step of exposing said barrier conductor layer to said first gas atmosphere, a metal film (120) on the barrier conductor layer by a CVD process (see column 10, lines 39-50);

exposing said metal film (120) to a second gas atmosphere at an elevated substrate temperature (see column 10, lines 39-67; column 11, lines 1-26);

(2) wherein said first reducing gas atmosphere is selected from any of the group consisting of silane, ammonia and hydrogen (see columns 8 and 9, lines 27-67 and lines 1-46, respectively)

(4) wherein said second gas atmosphere includes hydrogen and/or nitrogen (see column 11, lines 1-26);

(7) wherein said barrier conductor layer is formed of any of Ta or TaN (see column 9, lines 33-46);

(8) forming a barrier conductor layer (119) of any of tantalum nitride on a substrate (see column 9, lines 33-46);

forming, after said step of exposing said barrier conductor layer to said plasma, a metal film (120) on said barrier conductor layer by a CVD process (see column 10, lines 39-50);

(9) wherein said reducing gas is hydrogen (see column 9, lines 46-65);

(11) further comprising, after said step of forming said metal film, a thermal annealing process applied to said metal film (see column 10, lines 59-62);

(6); (13) wherein said metal film is formed of Cu (see column 10, lines 39-42);

(14) alternately and repeatedly forming, on a substrate, an insulating film, a barrier conductor layer, wherein... is interposed between said step of forming said barrier conductor layer and said step of forming said metal film (see columns 6, 9 and 10, lines 44-61, lines 33-67 and lines 39-67, respectively);

(15) wherein said step of forming said barrier conductor layer is conducted by a PVD process (see column 6, lines 44-67);

(16) wherein said second gas atmosphere includes nitrogen (see column 10, lines 39-67; column 11, lines 1-26).

Hausmann discloses the above outlined features except for exposing the barrier layer to a first gas atmosphere containing a reducing gas and free of plasma at an elevated substrate temperature. However, Lee discloses a method of fabricating a semiconductor device **(1); (8); (14)....** exposing the barrier layer to a first gas atmosphere containing a reducing gas and free of plasma at an elevated substrate temperature (see column 7, lines 18-25). It would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine and modify the teachings of Hausmann and Lee by exposing the barrier layer to a first gas atmosphere containing a reducing gas and free of plasma at an elevated substrate temperature to increase the diffusion barrier effect as taught by Lee during fabricating an interconnect structure. Also, by varying the temperature and pressure range of operational conditions during fabricating a semiconductor device to exceed its performance criteria. In re Aller, 105 USPQ 233 and In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Response to Arguments

Applicants argued that Hausmann uses plasma in the first exposure step, leading to inevitable damaging of the barrier metal surface. However, Lee discloses a method of fabricating a semiconductor device **(1); (8); (14)....** exposing the barrier layer to a first gas atmosphere containing a reducing gas and free of plasma at an elevated substrate temperature (see column 7, lines 18-25). It would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine and modify the teachings of Hausmann and Lee by exposing the barrier layer to a first gas atmosphere containing a reducing gas and free of plasma at an elevated substrate temperature during fabricating an interconnect structure.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chuong A Luu whose telephone number is (571) 272-1902. The examiner can normally be reached on M-F (6:30-3:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on (571) 272-1907. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

CAL
March 2, 2004

VUTHE SIEK
PRIMARY EXAMINER